

ATM

INDRA ADS-B SYSTEM

AUTOMATIC DEPENDANT SURVEILLANCE – BROADCAST

JULY -2014



indra

INDEX

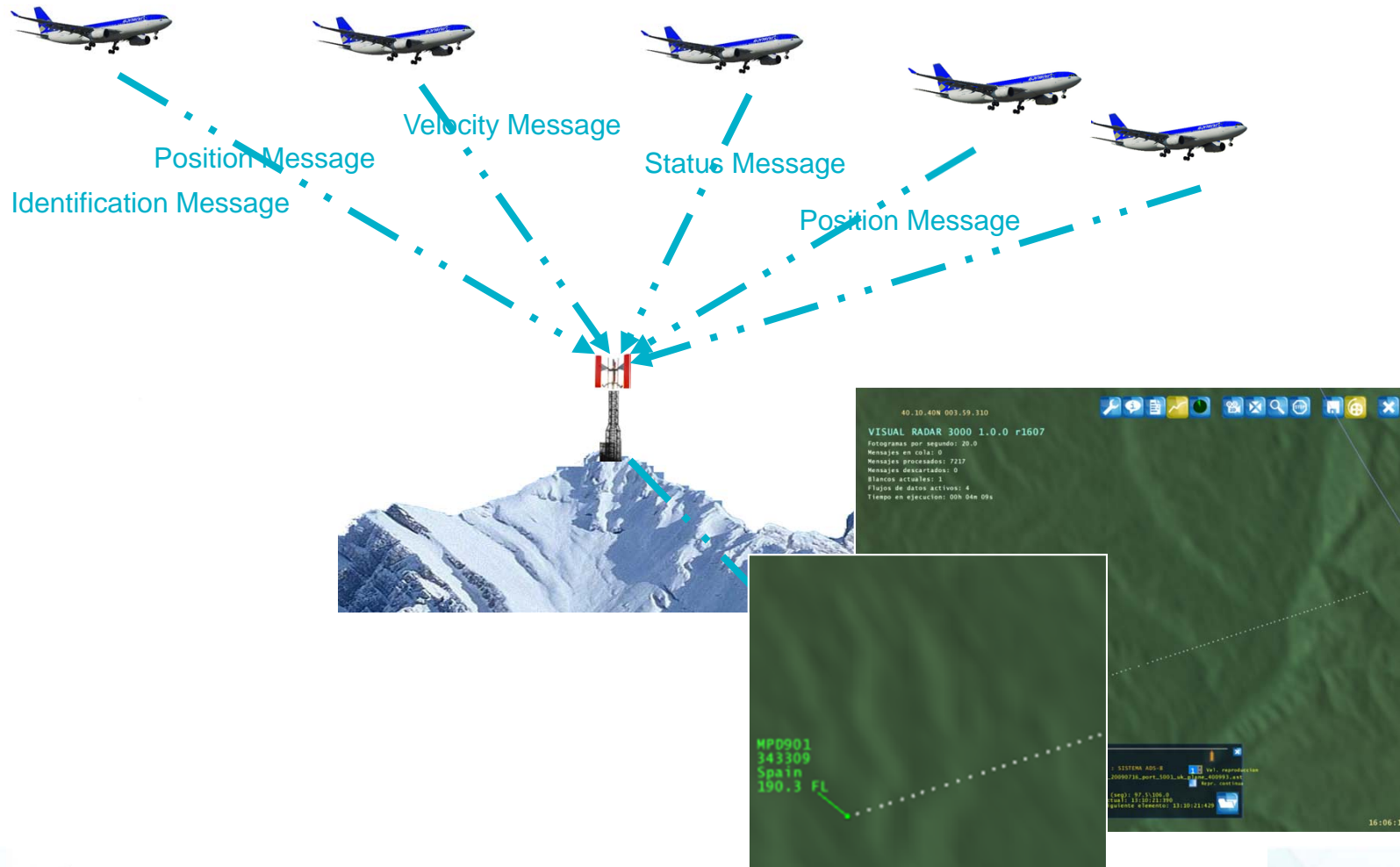
- 01 ADS-B in Air Traffic Management
- 02 ADS-B Regulations and Mandates
- 03 Indra ADS-B: Highlights
- 04 Indra ADS-B: System Design.
- 05 Indra Experience

DEFINITION

- **A**utomatic: Aircraft equipped with ADS-B transmit automatically information about Identification, Position, Velocity Vector, Flight Status....
- **D**ependant: Information depends on aircraft equipment capabilities.
- **S**urveillance: ADS-B provides surveillance over ADS-B equipped aircraft.
- **B**roadcast: Information is broadcast from the aircraft using 1090 MHz Extended Squitter messages in Mode S Down Format DF17.



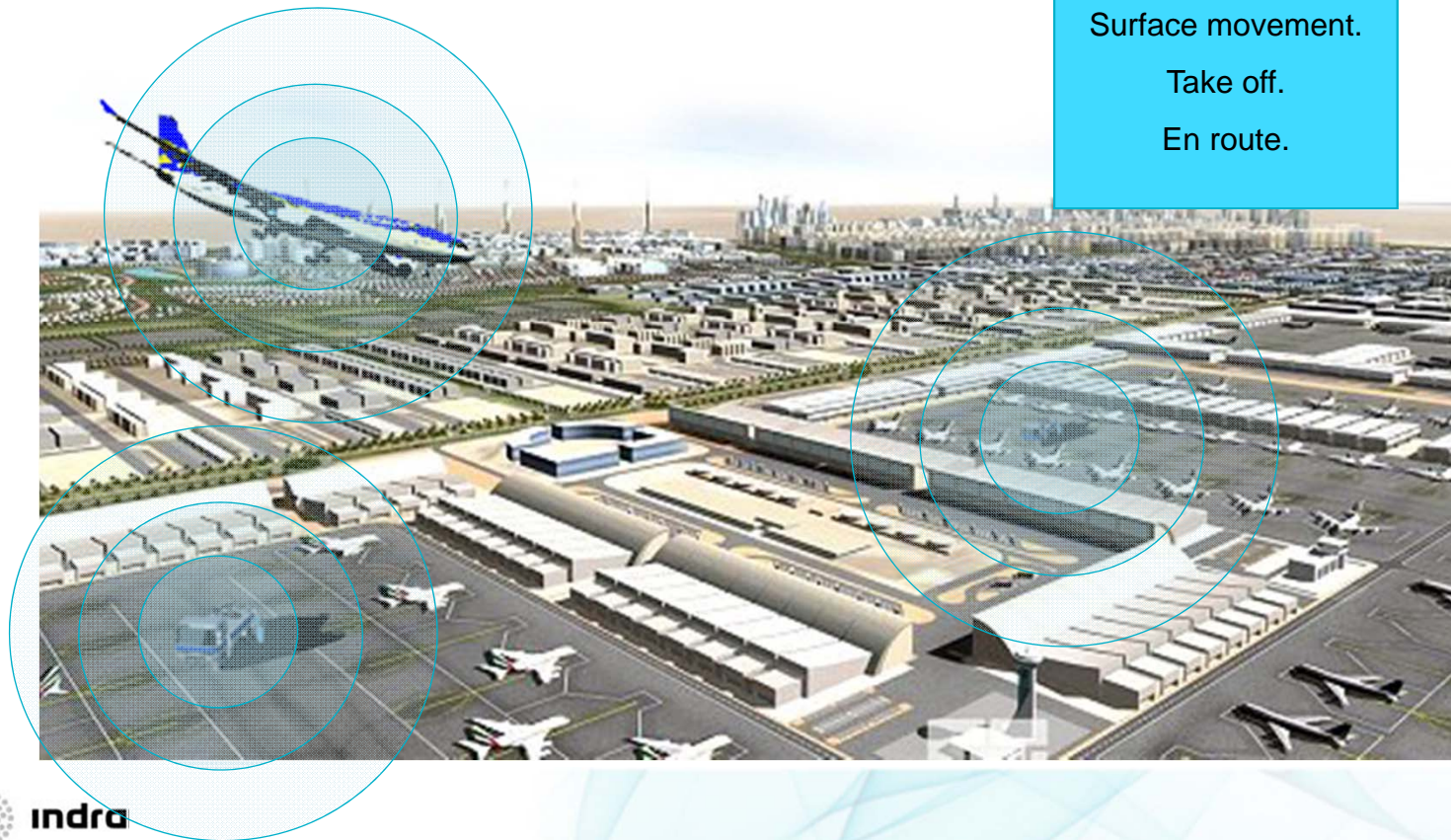
INFORMATION USED



ATM APPLICATIONS

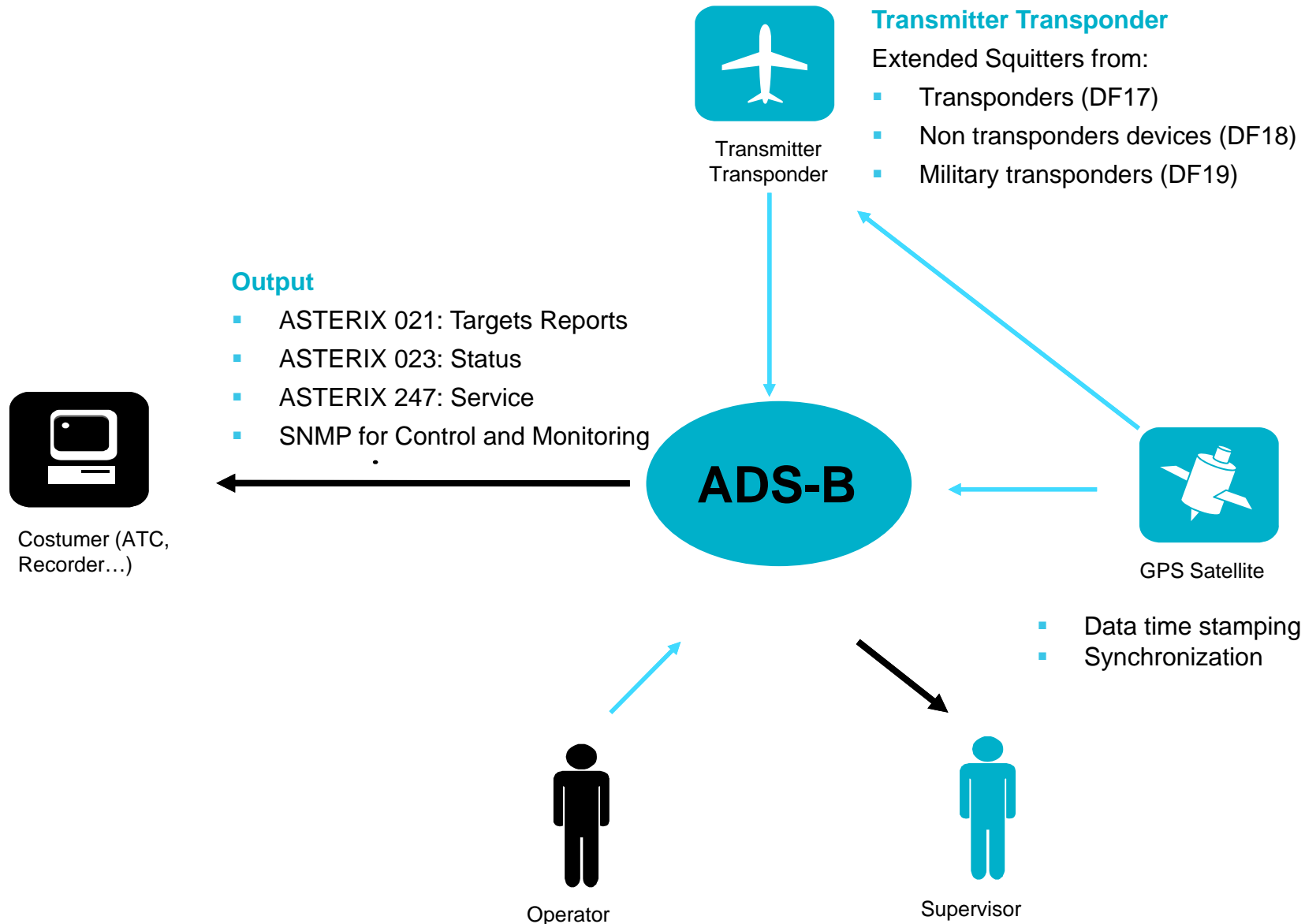


Approach.
Landing.
Surface movement.
Take off.
En route.



ADS-B IN AIR TRAFFIC MANAGEMENT

SYSTEM CONTEXT



MAIN BENEFITS

1. High data update rate: Once per 0,5 seconds in ADSB-GSS equipment (Configurable).

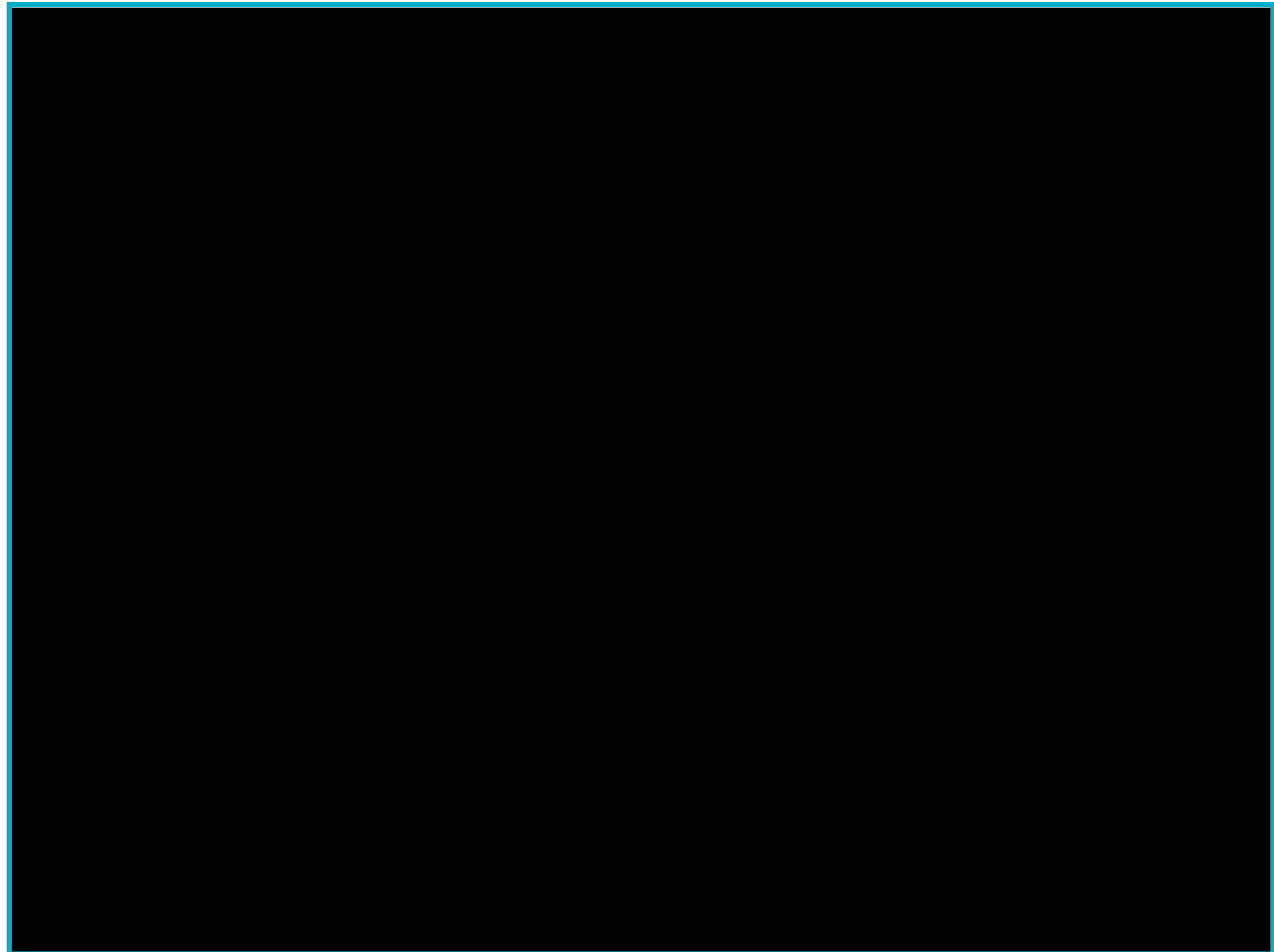
2. Accuracy:

Position reported by ADS-B is more accurate than current radar positions.

3. Lower Costs:

ADS-B reduces the costs of deployment & installation.

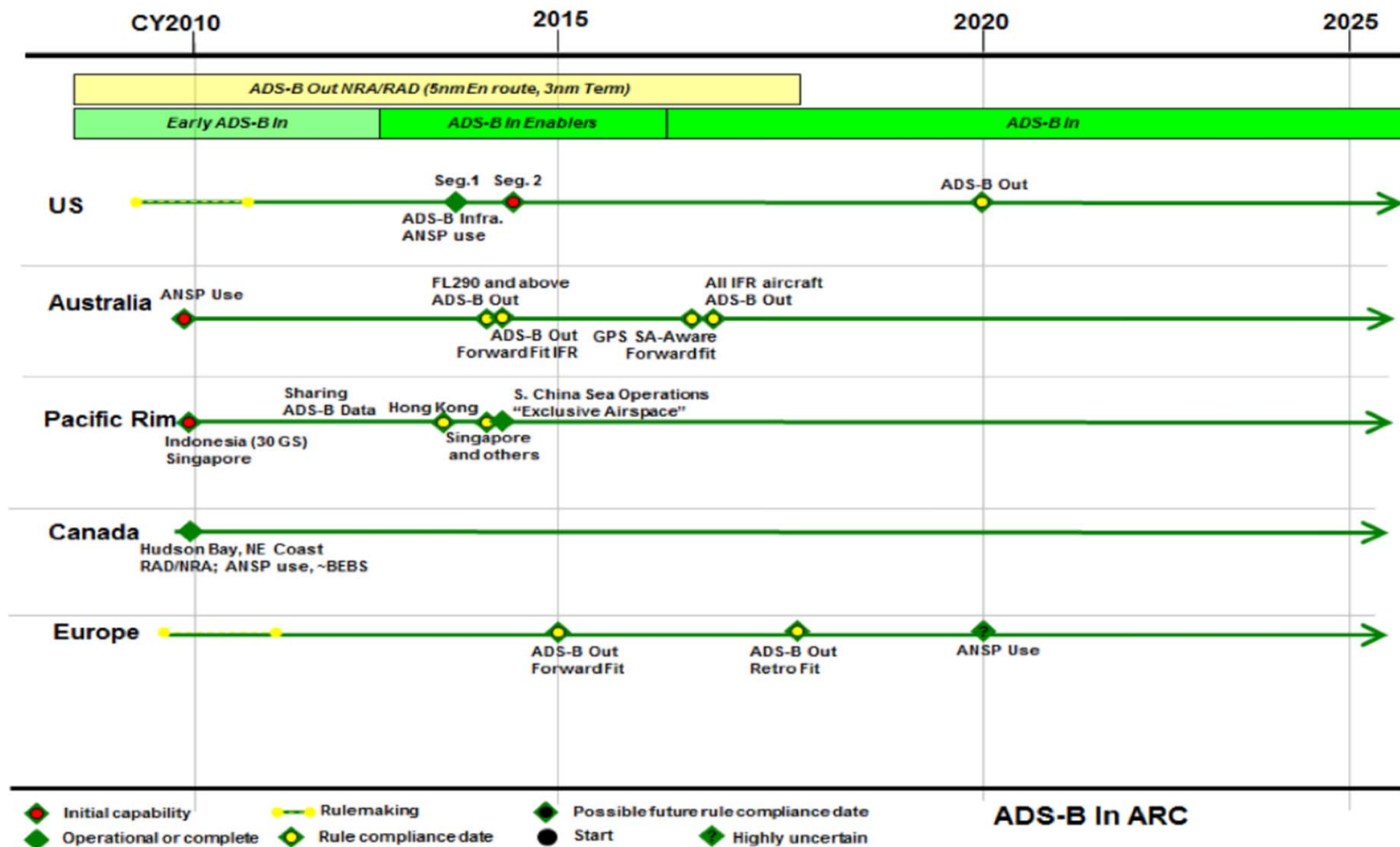
Operation & Maintenance costs also reduced (No rotating elements).



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ADS-B WORLD-WIDE REGULATIONS



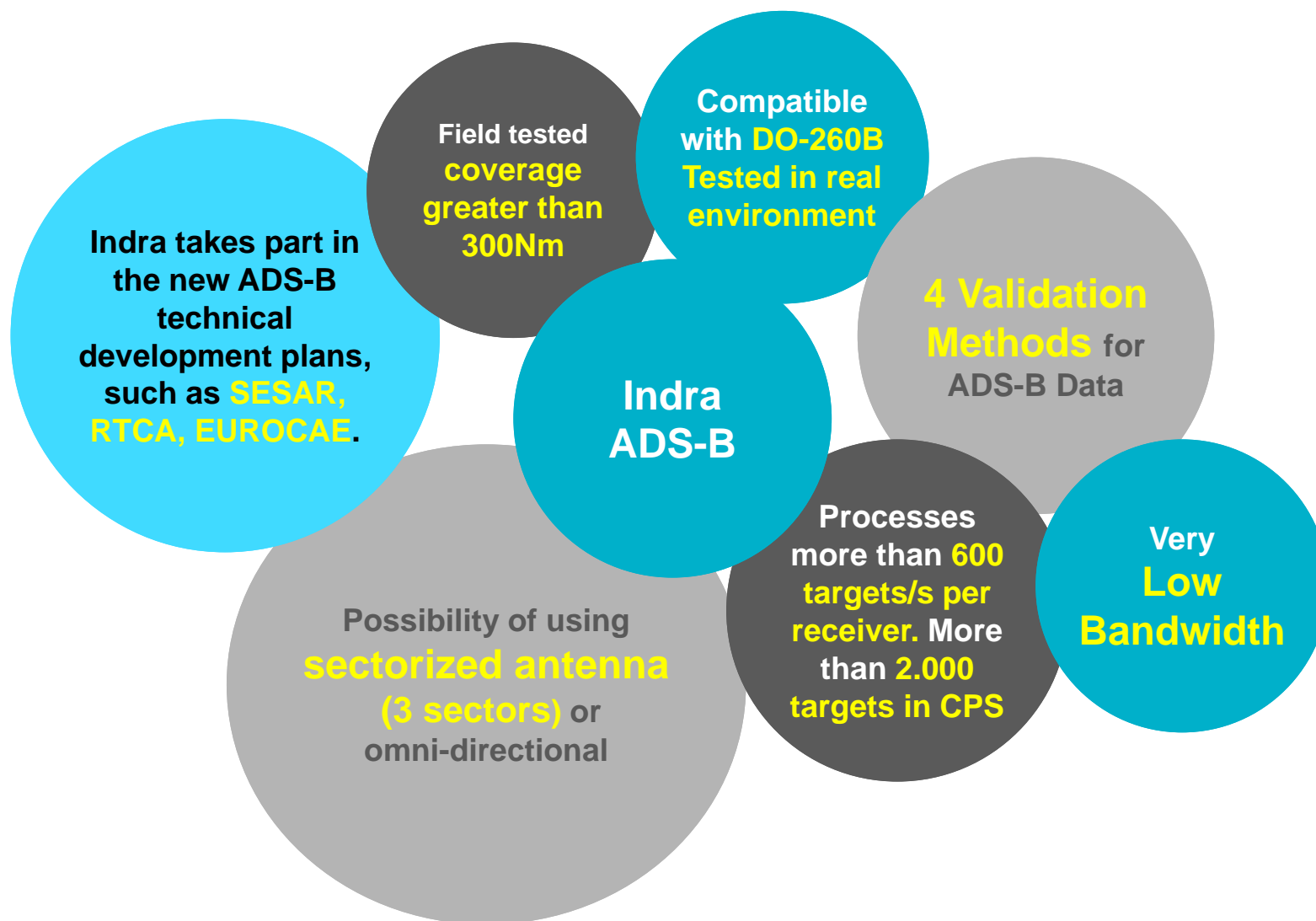
U.S.A: "By January 1, 2020 all aircraft operating on U.S. transponder airspace will be required to carry equipment that produces an ADS-B Broadcast."

Australia: "On and after 12 December 2013, any aircraft that is operated at or above FL 290 must carry ADS-B transmitting equipment..."

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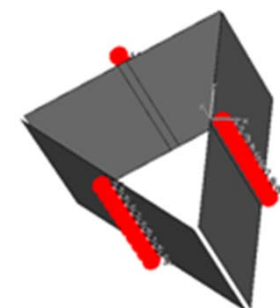
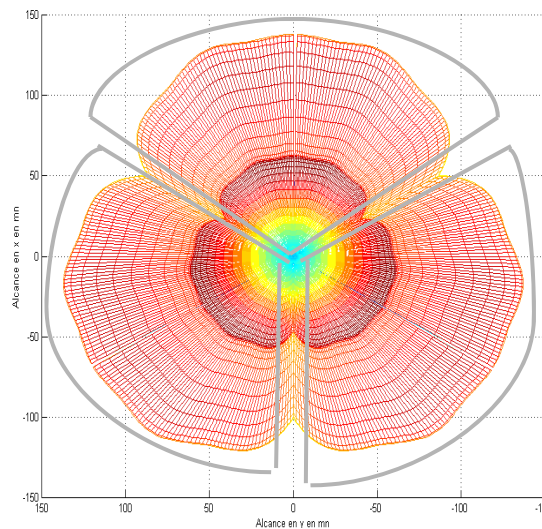
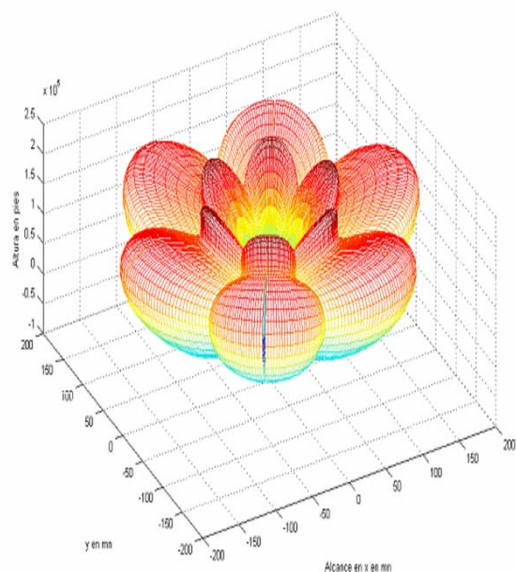
HIGHLIGHTS



VALIDATION OF ADS-B DATA

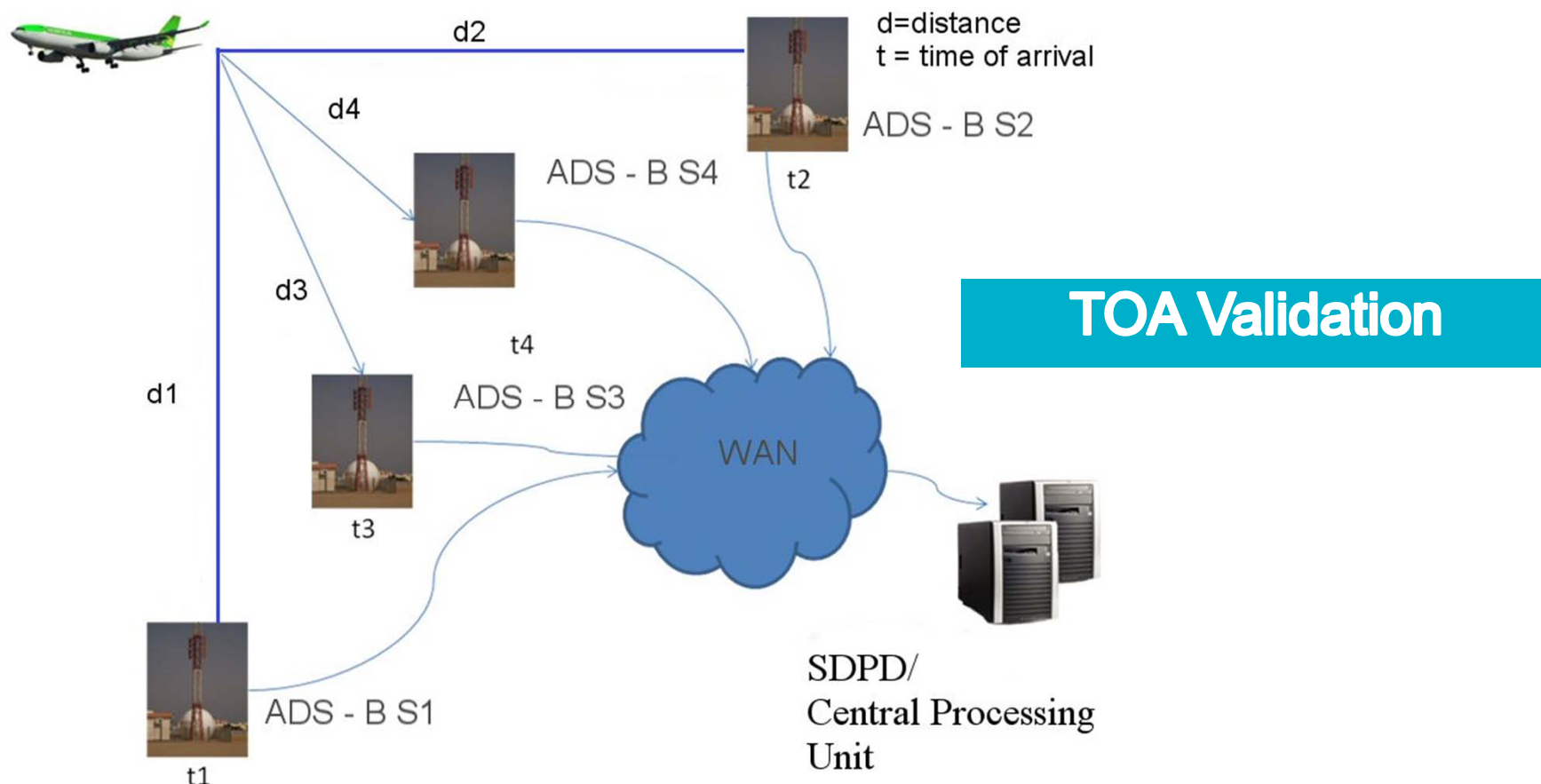
Indra ADS-B System provides 4 validation methods:

- 1. Angle of arrival validation:** The **sectorized antenna** of Indra's ADS-B System allows the determination of the direction or sector of arrival of the received messages, **this direction is correlated with the angle of arrival obtained from the position reported by the aircraft.**



VALIDATION OF ADS-B DATA

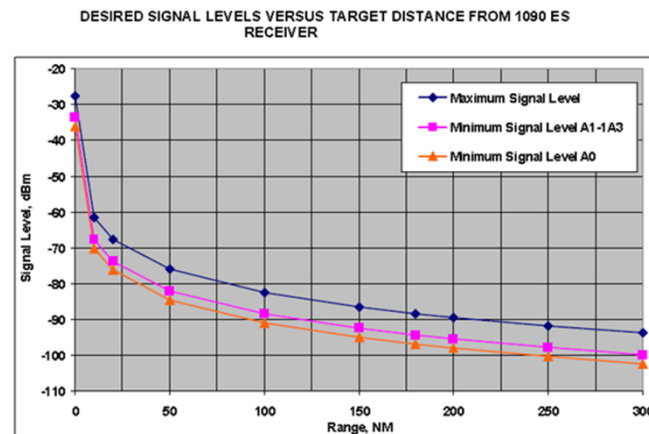
2. Time of arrival (TOA) validation: The principle of this validation method lies in the correlation between Time of Arrival of Extended Squitters and the reported distance from multiple receivers.



VALIDATION OF ADS-B DATA

3. Power measure versus range:

Depending on the type of transponder of the target and other parameters such as the antenna gain, height, distance, **Indra ADS-B system will expect to receive ES messages from a target that will be inside a range of power values.**



4. Target velocity against the ADS-B received target position change:

Actual and historic position and velocity information of the same target are also used to cross-check the credibility of both data items.

These validation methods have been developed and tested in SESAR program.

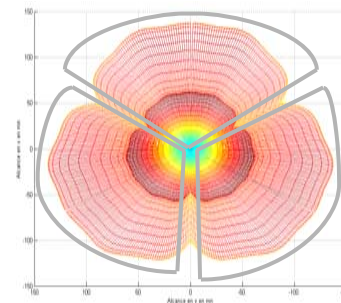
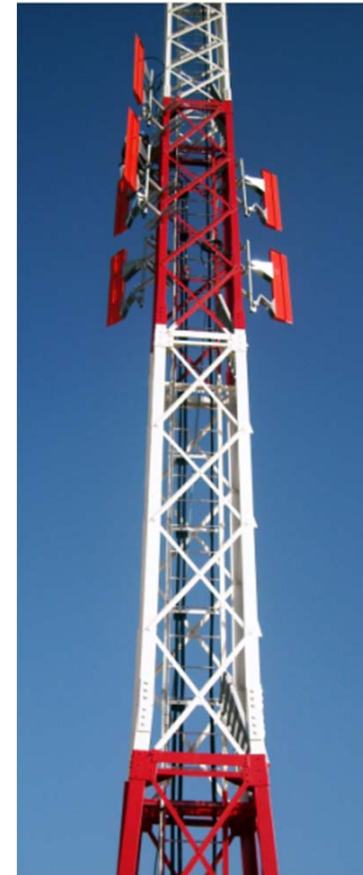
MULTICHANNEL RECEIVER

1. Indra Multichannel Receiver offers the capability of using a 3 sectors antenna:

Sectorized antennas are **easy to install since they do not need to be sited at the top of towers** and **admit other elements located in parallel**. On the other hand, omnidirectional antennas shall be installed with no other obstacles in parallel, which could be impossible on many occasions (i.e: Installation of ADS-B in a tower where existing radar is already installed at the top). **Reduces multipath and reflections.**

2. Reduces the noise and increase the range: Field-tested range beyond 300NM.

3. Possibility of using omni-directional antenna.



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SYSTEM DESIGN

ADS-B RECEIVER

Upgrades & Improvements:

- Higher sensitivity. 3 dB more than previous version. Better than -90dBm. (Range increased)
- ADS-B data validation methods
- Dual power supply
- Dual storage (RAID 2 Hard Drives Hot Swap)
- Automatic re-start after power outage
- Increase processing capability (600 targets)
- New graphical CMS integrated

Features:

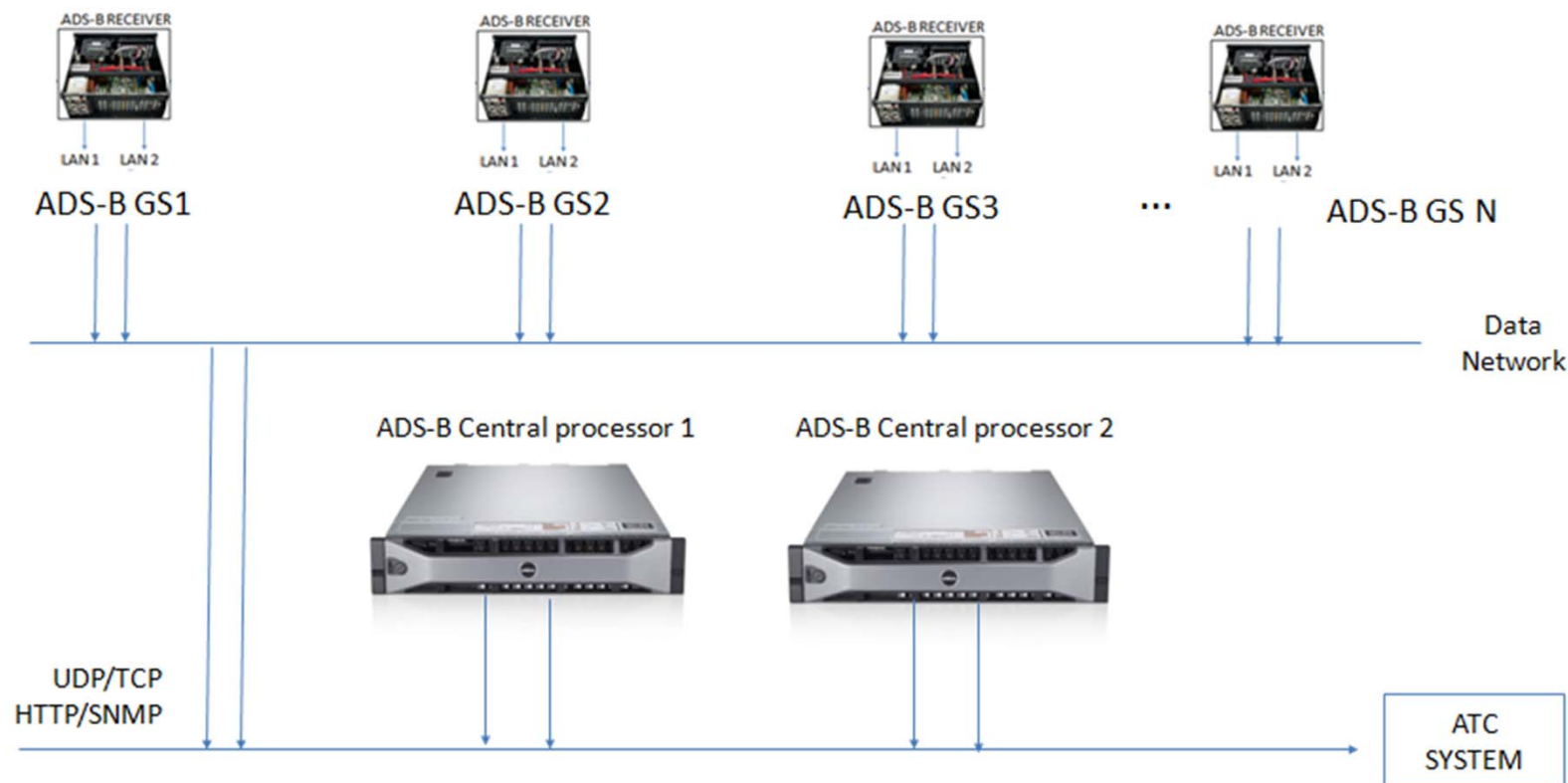
- Three (3) 1090 receivers inside
- Dual network interface
- Difference sizes & configurations
 - Rack mountable 19" or compact
 - Indoor/Outdoor



SYSTEM DESIGN

ADS-B CENTRAL PROCESSOR

- Used on ADS-B Networks with several receivers
- Only one interface with ATC System.
- **Fuses ADS-B data from up to 64 Ground Stations.**



ADS-B CENTRAL PROCESSOR

- **ADS-B Data Validation using TOA of several GSS**
- Accept different versions of Asterix 21 as an input and output the required Asterix 21 version to ATC System
- Processing Capacity for more than 2000 targets
- **Data filtering:**
 - By ICAO address
 - Using Asterix 023 and 247 information
 - By Quality indicators and FOM
 - By Altitude
 - By Area/Sector.
- LCMS integrated



CONTROL AND MONITORING SYSTEM

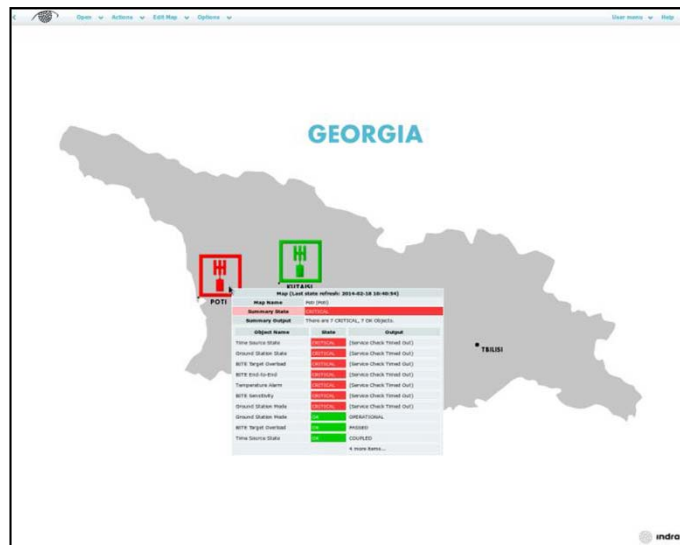
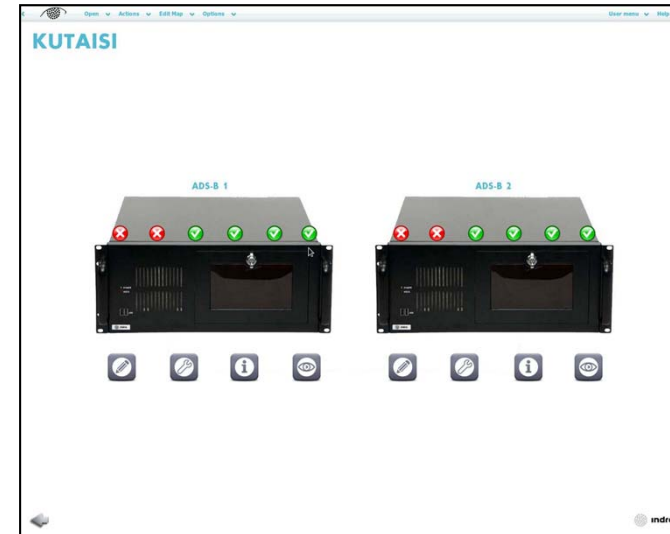
- Supervision of the status of each LRU
- Supervision of operating parameters
- Reports and alarms management
- Secure Access
- Control of operational parameters
- **Statistic analysis and historic values**
- SNMP and WEB



SYSTEM DESIGN

CONTROL AND MONITORING SYSTEM

- Supervision of each Ground Station
- Location of Ground Stations in map
- Monitoring and control of parameters



General

Home

Reports

Alerts

History

Summary

Histogram

Return to Administration

Return

Current Network Status

Last Update: Tue Feb 18 11:49:21 UTC 2014

Updated every 10 seconds

Registered: 0.5.1 - www.indra.org

Logged in: 0.5.1 - www.indra.org

New History For: All Hosts

View History For: All Hosts

View Host Status Detail For: All Hosts

Host Status Totals

Up: 4 Down: 0 Unreachable: 0 Pending: 0

13240454

All Problems: All Types

454320

Service Status Totals

OK: 4 Warning: 0 Unknown: 0 Critical: 0

All Problems: All Types

454320

Service Status Details For All Hosts

Limit Results

100

Hosts

KUTAISI ADS-B 1

Service

BITE Buffer Overload

Status

OK

Last Check

02-18-2014 11:49:09

Duration

00:20:18m:36s

Attempt

1/1

Status Information

PASSED

KUTAISI ADS-B 1

BITE CPU Overload

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

BITE End-to-End

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

BITE Interface LAN 1

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 1

BITE Interface LAN 2

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 1

BITE Network Overload

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

BITE Security

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

BITE Target Overload

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

General Canal 1 TTPPG BITE

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

General Canal 2 TTPPG BITE

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

General Canal 3 TTPPG BITE

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 1

General TTPPG BITE

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 2

General Station Mode

WARNING

02-18-2014 11:49:09

00:20:18m:36s

1/1

MAINTENANCE

KUTAISI ADS-B 2

Status of GPS Antenna

CRITICAL

02-18-2014 11:49:09

00:18:40m:17s

0/5

FAILED

KUTAISI ADS-B 2

Status of Time Synchronization

CRITICAL

02-18-2014 11:49:09

00:17:30m:37s

1/1

NOT ENFORCED

KUTAISI ADS-B 2

TTPPG Device Status

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 2

Temperature Alarm

OK

02-18-2014 11:49:09

00:20:18m:36s

1/1

PASSED

KUTAISI ADS-B 2

Type Source State

CRITICAL

02-18-2014 11:49:09

00:18:40m:17s

5/5

NOT COUPLED

KUTAISI ADS-B 2

BITE Buffer Overload

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

BITE CPU Overload

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

BITE End-to-End

CRITICAL

02-18-2014 11:49:09

00:18:40m:17s

1/1

FAILED

KUTAISI ADS-B 2

BITE Interface LAN 1

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

BITE Interface LAN 2

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

BITE Network Overload

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

BITE Security

CRITICAL

02-18-2014 11:49:09

00:15:12m:30s

1/1

FAILED

KUTAISI ADS-B 2

BITE Target Overload

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

General Canal 1 TTPPG BITE

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

General Canal 2 TTPPG BITE

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

General Canal 3 TTPPG BITE

WARNING

02-18-2014 11:49:09

00:18:40m:17s

1/1

WARNING

KUTAISI ADS-B 2

General TTPPG BITE

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

General Station Mode

WARNING

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

Status of GPS Antenna

CRITICAL

02-18-2014 11:49:09

00:18:40m:17s

1/1

CONNECTED

KUTAISI ADS-B 2

Status of Time Synchronization

CRITICAL

02-18-2014 11:49:09

00:18:40m:17s

1/1

NOT ENFORCED

KUTAISI ADS-B 2

TTPPG Device Status

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

Temperature Alarm

OK

02-18-2014 11:49:09

00:18:40m:17s

1/1

PASSED

KUTAISI ADS-B 2

Type Source State

CRITICAL

02-18-2014 11:49:09

00:18:40m:17s

5/5

NOT COUPLED

KUTAISI ADS-B 2

BITE Buffer Overload

CRITICAL

02-18-2014 11:49:40

00:18:17m:17s

1/1

(Server Check Timeout Out)

KUTAISI ADS-B 2

BITE CPU Overload

CRITICAL

02-18-2014 11:49:40

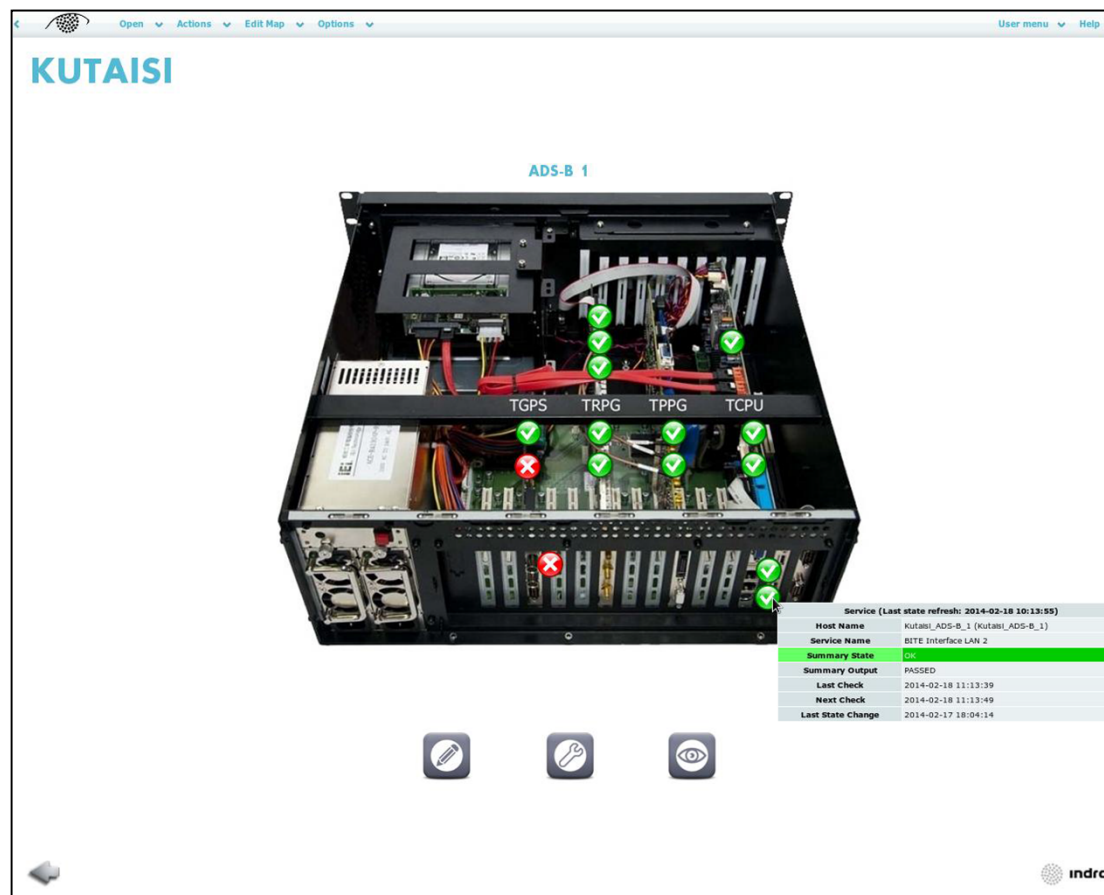
00:18:17m:17s

1/1

(Server Check Timeout Out)

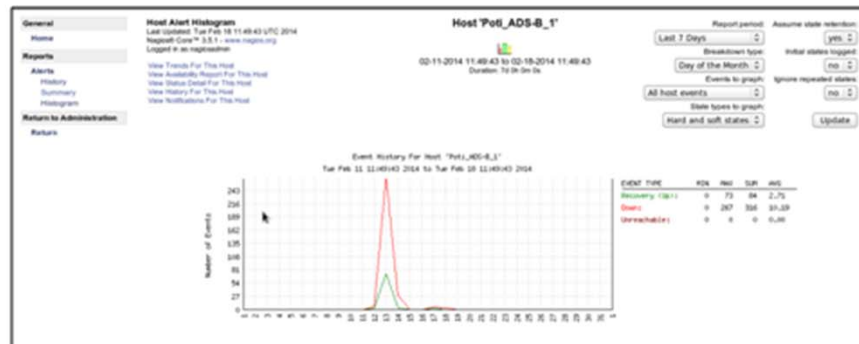
CONTROL AND MONITORING SYSTEM

- Supervision of the status of each LRU
- Friendly interface with visual location of each LRU



CONTROL AND MONITORING SYSTEM

- Statistical analyses and historical average values:



General

Home

Reports

Alerts

History

Summary

Histogram

Return to Administration

Return

Current Network Status

Last updated: Tue Feb 18 11:49:21 UTC 2014
Updated every 10 seconds
Nagios Core™ 3.5.1 - www.nagios.org
Logged in as nagiosadmin

View History For All Hosts
View Notifications For All Hosts
View Host Status Detail For All Hosts

Host Status Totals

Up Down Unreachable Pending

1 3 0 0

All Problems All Types

3 4

Service Status Totals

OK Warning Unknown Critical Pending

46 4 0 10 0

All Problems All Types

36 64

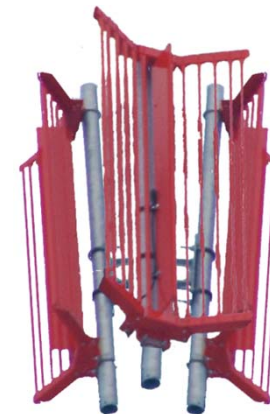
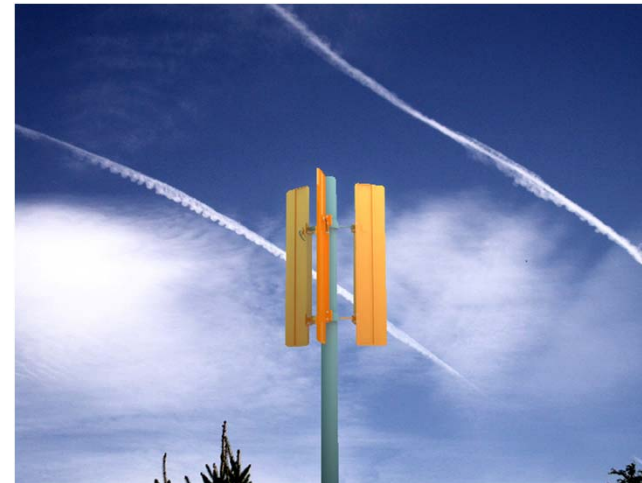
Service Status Details For All Hosts

Last Results: 100

Host	Service	Status	Last Check	Duration	Advisory	Status Information
Pot_ADS-B_1	BITE Buffer Overload	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	BITE CPU Overload	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	BITE End-to-End	OK	02-18-2014 11:49:00	0d 20m 25s 52u	1/1	PASSED
	BITE Interface LAN 1	OK	02-18-2014 11:49:00	0d 18m 42s 17u	1/1	PASSED
	BITE Interface LAN 2	OK	02-18-2014 11:49:00	0d 18m 45s 7u	1/1	PASSED
	BITE Network Overload	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	BITE Sensitivity	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	BITE Target Overload	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	General Canal 1 TRPG-BITE	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	General Canal 2 TRPG-BITE	OK	02-18-2014 11:49:00	0d 20m 18s 40u	1/1	PASSED
	General TRPG-BITE	OK	02-18-2014 11:49:00	0d 20m 18s 40u	1/1	PASSED
	General TRPG-BITE	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	General TRPG-BITE	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
	Ground Station Mode	WARNING	02-18-2014 11:49:00	0d 20m 35u	1/5	MAINTENANCE
	Ground Station State	CRITICAL	02-18-2014 11:49:00	0d 20m 17u	0/5	FAILED
	Status of GPS Antenna	CRITICAL	02-18-2014 11:49:00	0d 17m 30u 37u	1/1	NOT CONNECTED
	Status of Time Synchronization	CRITICAL	02-18-2014 11:49:00	0d 17m 30u 37u	0/5	NOT SYNCHRONIZED
	TRPG Device Status	OK	02-18-2014 11:49:00	0d 20m 18s 36u	1/1	PASSED
Temperature Alarm	OK	02-18-2014 11:49:00	0d 20m 18s 40u	1/5	PASSED	
Time Source State	CRITICAL	02-18-2014 11:49:00	0d 20m 17u	0/5	NOT COUPLED	
Pot_ADS-B_2	BITE Buffer Overload	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED
	BITE CPU Overload	OK	02-18-2014 11:49:00	0d 19m 46s 43u	1/1	PASSED
	BITE End-to-End	CRITICAL	02-18-2014 11:49:00	0d 19m 32u	1/1	FAILED
	BITE Interface LAN 1	OK	02-18-2014 11:49:00	0d 18m 42s 17u	1/1	PASSED
	BITE Interface LAN 2	OK	02-18-2014 11:49:00	0d 18m 46s 57u	1/1	PASSED
	BITE Network Overload	OK	02-18-2014 11:49:00	0d 19m 46s 43u	1/1	PASSED
	BITE Sensitivity	CRITICAL	02-18-2014 11:49:00	0d 19m 32u	1/1	FAILED
	BITE Target Overload	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED
	General Canal 1 TRPG-BITE	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED
	General Canal 2 TRPG-BITE	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED
	General Canal 3 TRPG-BITE	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED
	General TRPG-BITE	WARNING	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	WARNING
	General TRPG-BITE	OK	02-18-2014 11:49:00	0d 19m 46s 43u	1/1	PASSED
	General TRPG-BITE	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED
	Ground Station Mode	WARNING	02-18-2014 11:49:00	0d 19m 17u 32u	1/5	MAINTENANCE
	Ground Station State	CRITICAL	02-18-2014 11:49:00	0d 19m 46s 3u	0/5	FAILED
	Status of GPS Antenna	OK	02-18-2014 11:49:00	0d 19m 46s 43u	1/1	CONNECTED
	Status of Time Synchronization	CRITICAL	02-18-2014 11:49:00	0d 19m 46s 3u	0/5	NOT SYNCHRONIZED
TRPG Device Status	OK	02-18-2014 11:49:00	0d 19m 46s 53u	1/1	PASSED	
Temperature Alarm	OK	02-18-2014 11:49:00	0d 19m 46s 43u	1/5	PASSED	
Time Source State	CRITICAL	02-18-2014 11:49:00	0d 19m 46s 17u	0/5	NOT COUPLED	
Pot_ADS-B_3	BITE Buffer Overload	CRITICAL	02-18-2014 11:49:00	0d 20m 18s 17u	1/1	(Service Check Timed Out)
	BITE CPU Overload	CRITICAL	02-18-2014 11:49:00	0d 20m 18s 17u	1/1	(Service Check Timed Out)

ANTENNAS

- The Antenna Subsystem is composed of:
 - Three Sectorized antennas or
 - One Omni-directional antenna
 - RF Filters
 - Mast head box with LNA (Optional)
- Antenna columns are directional. Each column covers a minimum of 120°. This increases the range and reduces the noise received at each channel.
- Antenna Gain Options:
 - 12 dB for Long Range
 - 9 dB for Medium- Long Range
 - 5 dB Medium Range
 - 2 dB Airport Surveillance
- Options & Upgrades: Solar Panel , Diesel Generator and batteries for Outdoor.



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EXPERIENCE

- More than 8 years of ADS-B experience.

Country	Units	Customer
Morocco	6 (3x2) ADS-B	ONDA
Peru	2 (1x2) ADS-B	CORPAC
Barranquilla (Colombia)	20 (10x2) ADS-B	ACC
Libia (Tripoli and Benghazi)	4 (2x2)	LCAA
Mongolia	5 (5x1) ADS-B	MCAA
Georgia	4 (2x2) ADS-B	SAKAERONAVIGATSIA
France	1 (1X1) ADS-B	EUROCONTROL
Switzerland	2 (1x2) ADS-B	RUAG
Tegucigalpa (Honduras)	1 ADS-B	COCESNA
Turkey	2 (1X2) ADS-B	DHMI
Pakistan	1 ADS-B	PCAA
Colombia (Río Negro)	1 ADS-B	ACC
Barcelona (Spain)	32 (ADS-B +MLAT)	AENA
Vilnius (Lithuania)	11 (ADS-B +MLAT)	ORO NAVIGACIJA
Bogota (Colombia)	26 (ADS-B +MLAT)	ACC



Thank you

Indra
Air Traffic

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